***New Phytologist* Supporting Information**

Article title: **Connecting active to passive fluorescence with photosynthesis: a method for evaluating remote sensing measurements of chlorophyll fluorescence**

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The following Supporting Information is available for this article:

Table S1.

Table S1. Nomenclature for additional parameters derived from pulse-amplitude modulation (PAM) fluorescence and spectrally derived fluorescence.

PAM parameter	PAM units	PAM calculation	PAM measuring interval	PAM measuring frequency	Light source driving F_{PAM} parameter	**Spectral parameter**	Spectral units	Spectral parameter calculation	Spectral measuring interval	Light source driving F_{λ} parameter	Traditionally known as
$\mathbf{F_o}$	mV	DC voltage from baseline (∫mV>700 nm)	5.0 s avg.; 1.0 s int.	Once post-dark adaptation	blue modulated measuring light	$\mathbf{F_{o,\lambda}}$	mW m^{-2} nm^{-1} sr^{-1}	F_{λ}average when ML on in dark	0.2 s avg.; 10 µs int.	blue modulated measuring light	Minimum Chl a fluorescence intensity in dark-adapted state
$\mathbf{F_t}$	mV	DC voltage from baseline (∫mV>700 nm)	5.0 s avg.; 1.0 s int.	Every 5 s post intital F_o	blue modulated measuring light	$\mathbf{F_{ML,\lambda}}$	$\frac{(mW\ m^{-2}\ nm^{-1}\ sr^{-1})}{(mW\ m^{-2}\ nm^{-1}\ sr^{-1})}$	See Figs. 2 & 4 (F_{λ} avg. ML on) – (F_{λ} avg. ML off)	once per light regime	blue modulated measuring light	minimum fluorescence intensity derived from the modulating light

*Derivation of parameters, such as absolute units, their calculation, measuring interval (including averaging period (avg.) and integration time (int.), and frequency are provided. F_o is minimum fluorescence intensity under the modulating light from PAM; F_t is transient fluorescence intensity from PAM; mV is millivolts; DC is direct current; $F_{o,\lambda}$ is spectral fluorescence from the modulating light; ML is modulating light $F_{ML,\lambda}$ is spectral fluorescence driven by the modulating light.

Fig. S1. Example spectra to demonstrate derivation of maximal spectral fluorescence ($F_{m,\lambda}$) from initial saturating pulse for *A. palmatum* under both conditions **(a)** and *Q. lobata* under both conditions **(b)**. For scale, the complete spectra of the saturation pulse is not shown. In addition, example spectra of an enlarged area show the derivation of steady-state spectral fluorescence (F_{λ}) under the modulating light only (dashed lines) and under 50 µmol m^{-2} s^{-1} (solid lines) for *A. palmatum* under both conditions **(c)** and *Q. lobata* under both conditions **(d)**. Here, the magnitude of the actinic light and modulating light are also not shown.

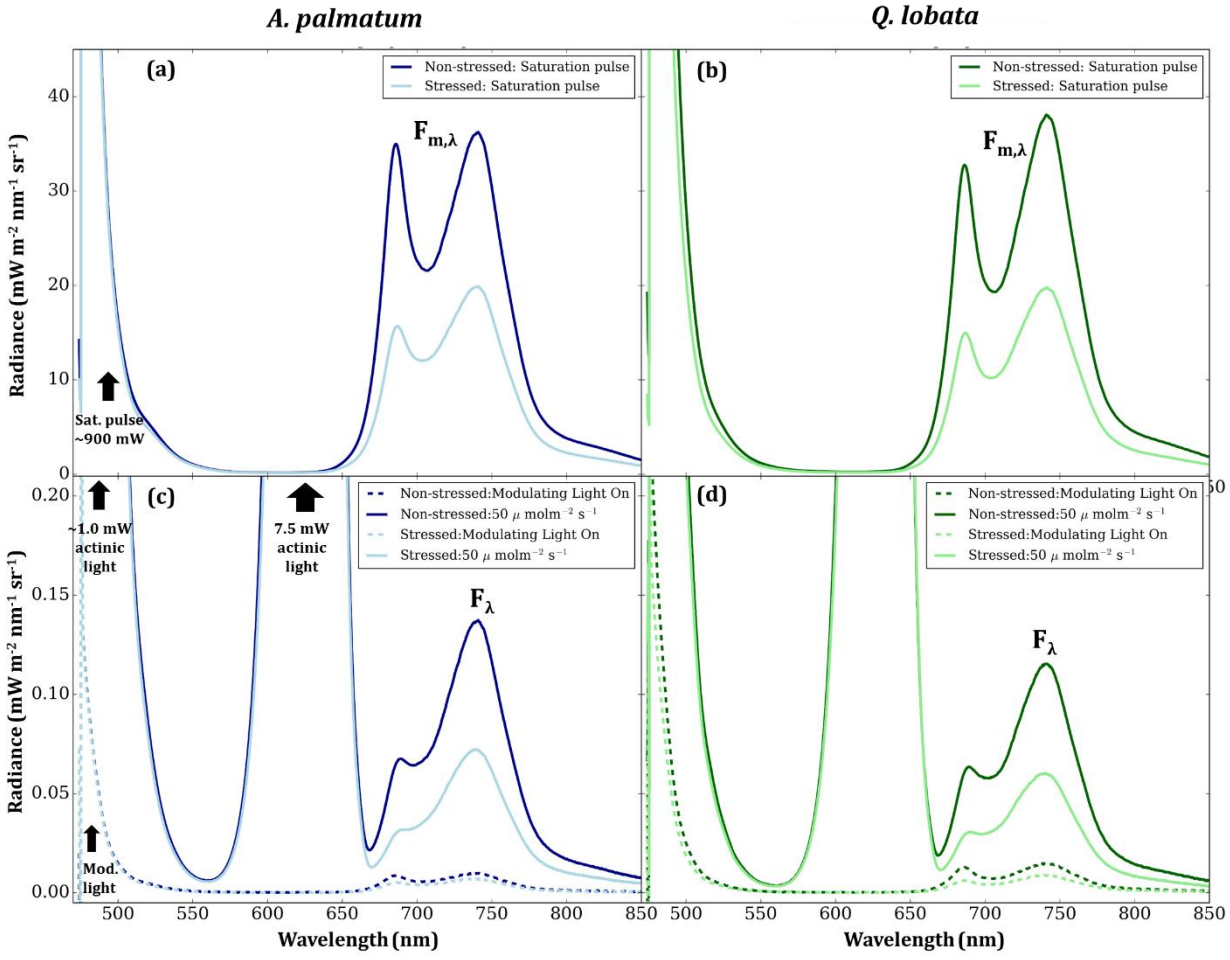

Fig. S2. Light response curves for **(a)** net photosynthesis (A_{net}), and **(b)** stomatal conductance (g_s) for both species and conditions. Points are the means of steady-state A_{net} and g_s during each light regime and error bars represent standard errors. PAR is photosynthetically active radiation.

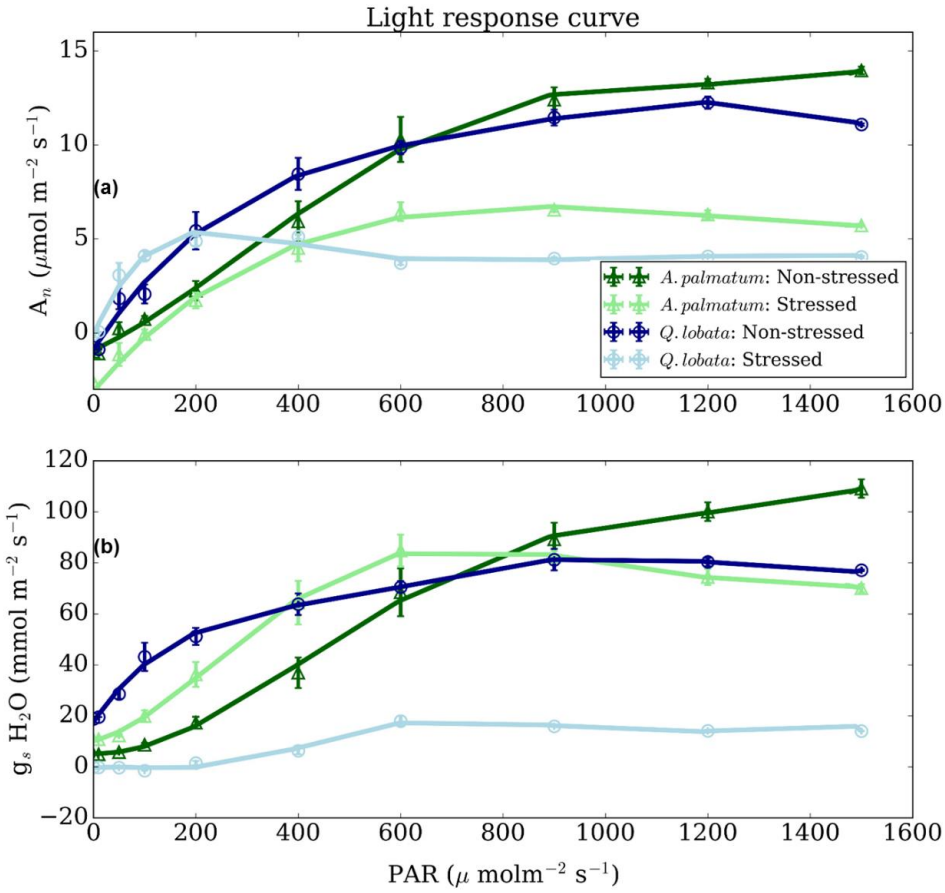

Fig. S3. Complete timeseries of example spectra from 740 nm (red), 686 nm (blue), 757 nm (green), and 771 nm (purple) for spectral fluorescent radiant flux (F_λ) **(a-d)**, spectral fluorescence yield ($\Phi F_{t,\lambda}$) **(e-h)**, and maximum spectral fluorescence ($F_{m,\lambda}$, $F_m'_{,\lambda}$) **(i-l)** for *A. palmatum* under non-stressed **(a, e, i)** and stressed conditions **(b, f, j)**; and for *Q. lobata* under non-stressed **(c, g, k)** and stressed conditions **(d, h, l)**. The x –axis shows the time in minutes from the beginning of the light regime and an inset showing the PAR during each light regime is provided in **(d).** Transient fluorescence from pulse-amplitude modulation (PAM F_t) (black circles) **(e-h)** and maximum fluorescence from PAM F_m, F_m‘ (black +) **(i-l)** are provided in relative units for temporal comparison on the second y-axis.

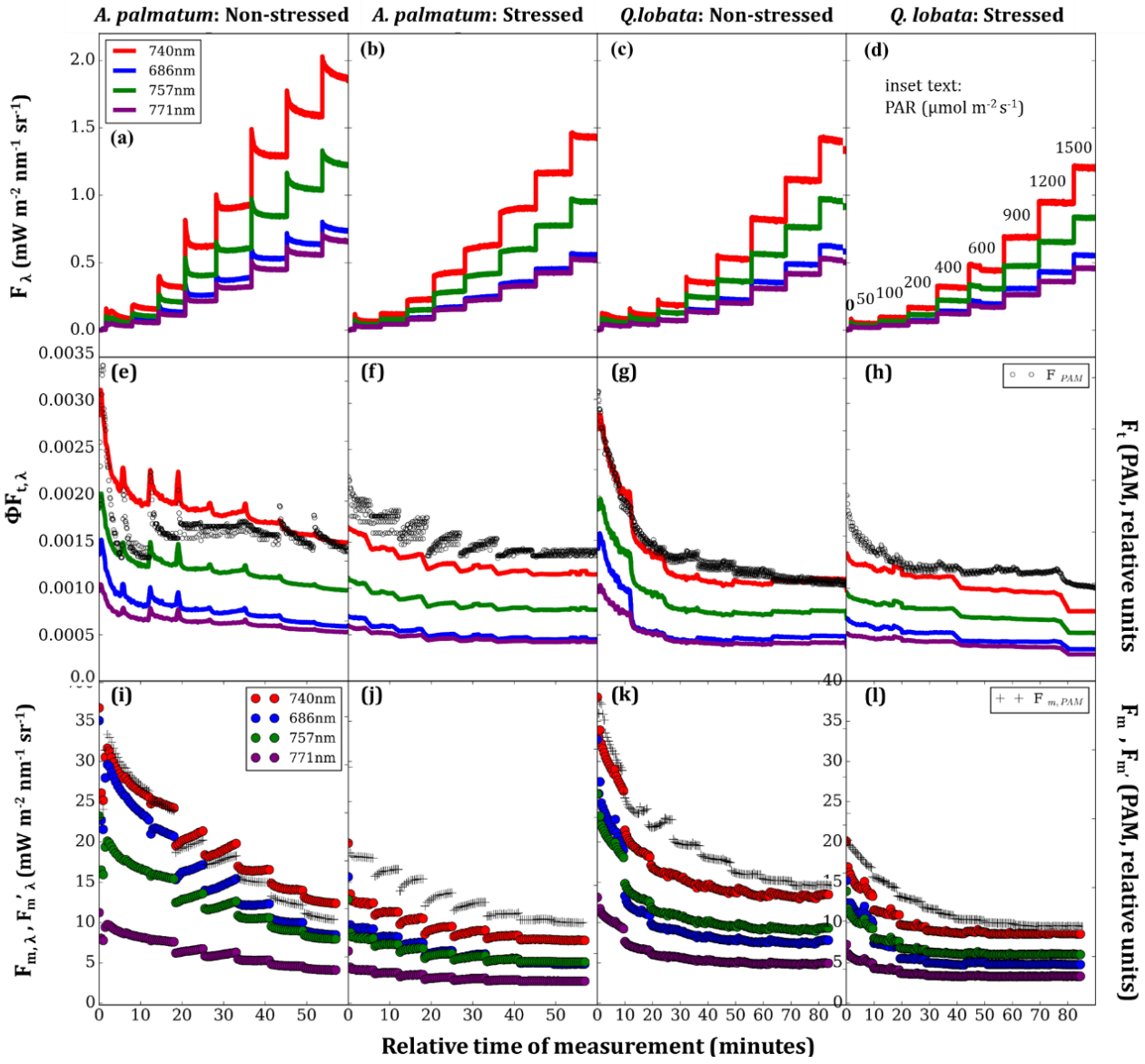

Fig. S4. Conceptual figure showing the derivation of spectral fluorescence emission (F_λ) from the modulating light ($F_{ML,\lambda}$). **(a)** Shows F_λ curves for *Q. lobata* (non-stressed) at 600 photosynthetically active radiation (PAR) taken during the times shown in **(c)**. **(b)** Highlights the difference between the ML on and ML off signals, which are ultimately used to derive $F_{ML,\lambda}$.

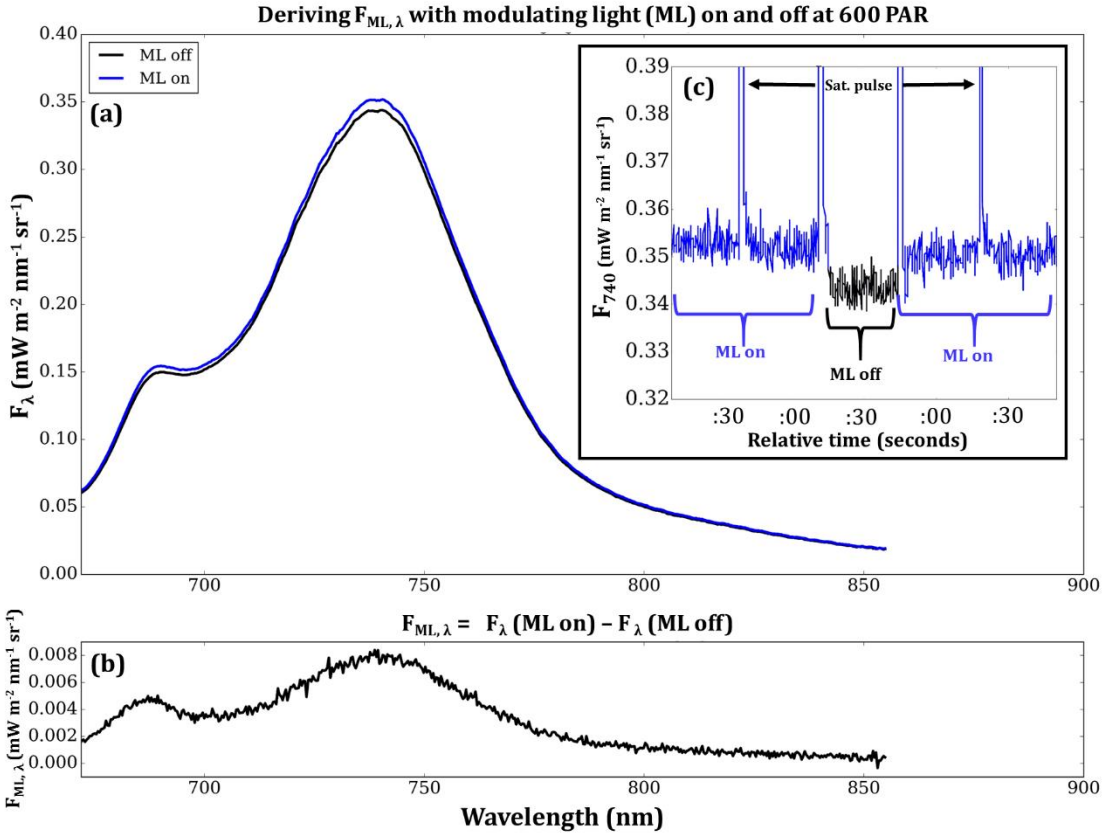

Fig. S5 (a) Relationship between transient fluorescence (F_t) derived from pulse-amplitude modulation (PAM) and spectrally derived modulated fluorescence intensity ($F_{ML,\lambda}$) using the difference between modulating light (ML) on and off as shown in Fig. S4 for five example wavelengths including the average spectra between 700 and 800nm. **(b)** Shows the wavelength specific relationships between $F_{ML,\lambda}$ and F_t, with the black line including minimum fluorescence intensity F_o from PAM (as shown in (a), and the gray line not including F_o).

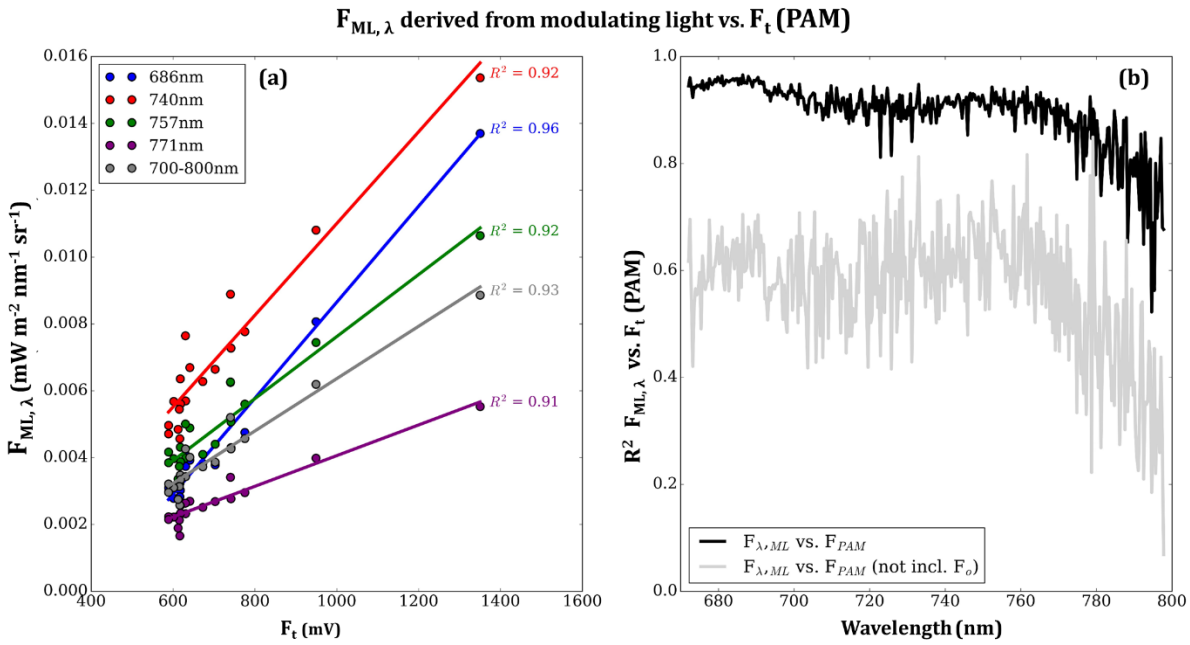

Fig. S6 Conceptual figure highlighting the derivation of all spectral fluorescence parameters (F_λ) and pulse-amplitude modulation (PAM) fluorescence parameters during the full first 14 minutes of a light response curve. **(a)** Shows data during saturation pulse, **(b)** Shows an enlarged version to highlight F_λ, and **(c)** highlights spectral fluorescence yield data ($\Phi F_{t,\lambda}$). This figure is an extended version of the more simplified Fig. 2.

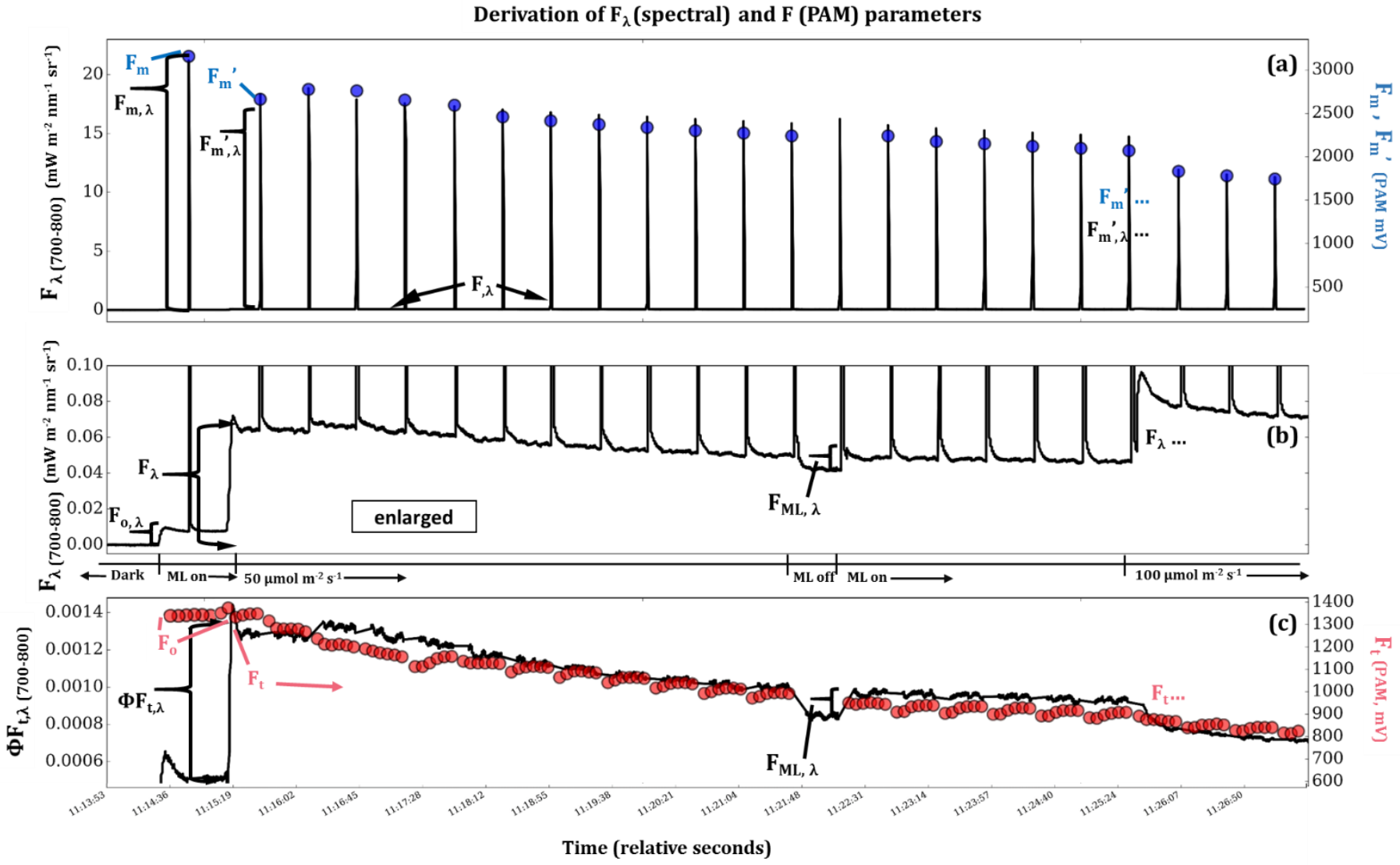

Fig. S7 Relative differences in spectral fluorescence emission (F_λ) curves separated for: **(a)** *A. palmatum* non-stressed; **(b)** *A. palmatum* stressed; **(c)** *Q. lobata* non-stressed; and **(d)** *Q. lobata* stressed. This differs from Fig. 5 in that it includes F_λ from the modulating light in darkness ($F_{o,\lambda}$) and in the presence of actinic light ($F_{ML,\lambda}$). Note that the F_{ML} test was only done for the *Q. lobata* runs and that all spectra are normalized for the spectral maxima.